

Harnessing the power of artificial intelligence in medicine: Insights of future medical professionals

Challenges and opportunities of AI in medical training

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Abstract

Aim: In this study, it was aimed to investigate future medical professionals' perspectives on the advantages, disadvantages, and importance of artificial intelligence (AI) in medicine.

Material and Methods: A survey was conducted among two groups: preclinical and clinical medical students (including residents). The survey consisted of questions regarding AI's advantages, disadvantages, and importance in medicine. The responses were collected and analyzed to identify prevailing trends and patterns within each group.

Results: In the preclinical group, over 50% of respondents acknowledged the advantages of AI in medicine, including the potential for more accurate diagnoses and treatment recommendations, faster and more effective treatment processes, and a reduced workload for doctors. However, ethical and confidentiality concerns, uncertainty about AI's accuracy, and the attribution of medical errors to AI were identified as potential disadvantages. Similar sentiments were echoed by the clinical group, with a majority recognizing the advantages of AI in medicine, particularly in terms of accurate diagnoses, efficient treatment processes, and reduced doctor workload. Ethical and confidentiality issues and concerns about AI accuracy were also highlighted as potential drawbacks.

Discussion: The findings of this study underscore the potential advantages of AI in medicine, such as improved diagnostics, treatment recommendations, and overall healthcare efficiency. However, ethical and confidentiality considerations and concerns regarding AI accuracy should be carefully addressed. By embracing AI responsibly, the medical community can harness its transformative potential to enhance patient care and drive innovation in healthcare practice.

Keywords

Artificial Intelligence in Medicine, Medical Education, Workload Reduction, Future Medical Professionals

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Introduction

In recent years, the intersection of medicine and technology has witnessed a remarkable transformation, with AI emerging as a groundbreaking force in healthcare. As medical professionals strive to deliver accurate diagnoses, effective treatments, and optimized patient care, the integration of AI holds immense promise. Understanding the perspectives of future medical professionals, who will navigate this evolving landscape, becomes crucial in harnessing the potential of AI in medicine [1, 2].

This article delves into the opinions of medical students and assistant doctors, serving as a window into the minds of those poised to shape the future of healthcare. With their fresh perspectives and intimate knowledge of medical practice's challenges and aspirations, these future professionals provide valuable insights into AI's advantages, disadvantages, and importance in medicine.

The era of AI offers numerous advantages that have captured the imagination of the medical community. The speed and efficacy of treatment processes also come into focus, alongside the potential to alleviate the overwhelming workload borne by doctors [3].

Beyond the advantages and challenges, the role of AI in medical education takes center stage. For preclinical and clinical students, exposure to AI technologies during their formative years is vital preparation for the future work environment [4]. Understanding how to effectively leverage AI in medical practice empowers these future professionals and positions them to contribute to the ongoing development of healthcare [5].

While exploring the advantages and disadvantages of AI, it is essential to consider the perspectives of medical students poised to enter the healthcare workforce. Using AI technologies in their education and training prepares them for the future work environment, and it empowers them to contribute to developing and refining AI applications in medical practice [6, 7]. Understanding the importance of AI for medical students sheds light on the role of AI education, fostering a new generation of healthcare professionals equipped with the necessary skills to leverage these transformative technologies effectively [8].

By examining future medical professionals' perspectives, this article sheds light on AI's potential advantages and disadvantages in medicine. It also underscores the importance of incorporating AI education into the medical curriculum, ensuring that aspiring doctors are equipped with the skills and knowledge necessary to embrace the transformative potential of this technology.

Material and Methods

This study was carried out with the permission of the Giresun Training and Research Hospital Clinical Researches Ethics Committee (Date: 28.04.2023, Decision No: 16). We confirm that all methods used in this study comply with the relevant guidelines and regulations. The participation of students was completely voluntary, informed consent was obtained from all participants, and all participants were above 18. The study was conducted per the Declaration of Helsinki, revised in 2013.

This study employed a cross-sectional survey design to gather insights from two distinct groups: preclinical medical students (1st, 2nd, and 3rd term) and clinical students (4th, 5th, and 6th term medical students and resident doctors). The survey questionnaire comprised two parts to capture demographic and socio-cultural data and opinions and perceptions of AI in medicine.

The participants in this study were selected from medical schools within the same region. The preclinical group comprised students in their early stages of medical education, while the clinical group

included students in later stages and resident doctors. Participation in the study was voluntary, and confidentiality and anonymity were ensured.

The survey questionnaire was carefully designed to cover a wide range of relevant factors. The survey was conducted online, and participants were recruited through convenience sampling. A total of 118 participants were included in the study, with 50 in the preclinical group and 68 in the clinical group. The questionnaire comprised 26 questions, including demographic and socio-cultural queries about knowledge and attitudes towards artificial intelligence in medicine. The first part focused on gathering demographic and socio-cultural data, including age, gender, family type, personality type, perceived family income, mother's and father's education, mother's and father's employment, place of residence, regular newspaper/book reading habits, computer knowledge level, and any previous computer-related training. The second part of the questionnaire assessed participants' awareness, attitudes, and perceptions regarding AI in medicine. It included questions such as whether they were aware of AI and its applications, concerns about AI's increasing presence in society, knowledge about AI applications in medicine, interest in using AI in their future medical careers, opinions on the inclusion of AI training in medical education, and their views on the advantages and disadvantages of AI in medicine. Additionally, specific questions focused on the importance of AI for medical professionals and their engagement in research related to AI. The survey was administered online, utilizing a secure platform that ensured data privacy and integrity. Participants were given a unique link to access the survey and sufficient time to complete the questionnaire. Data were collected over a specified period, allowing for a representative sample from preclinical and clinical groups.

Quantitative data obtained from the survey responses were analyzed using appropriate statistical methods. Descriptive statistics, including frequencies and percentages, were calculated to summarize the demographic and socio-cultural data. Comparative analyses, such as chi-square tests or t-tests, were performed to identify significant differences in responses between the preclinical and clinical groups. The statistical significance level was set at $p < 0.05$.

The survey data were analyzed, and the results of the questions that shaped the focus of this article were identified. Specifically, the responses to questions regarding concerns about AI's prevalence, interest in using AI in medical careers, and the desire for AI applications in medical school were explored. The disparity in perceived unemployment risk due to AI between the preclinical and clinical groups was also examined.

Statistical analysis

Categorical data were expressed as numbers (n) and percentages (%), while quantitative data were presented as mean \pm SD or median (25th-75th) percentiles, where appropriate. The Kolmogorov-Smirnov test was used to investigate whether the standard distribution assumption was met. While mean differences between groups were compared with Student's t-test, the Mann-Whitney U test was applied to compare not normally distributed data. Data analysis was performed using the IBM SPSS Statistics version 22.0 software (IBM-SPSS Inc., Chicago, IL, USA). A p value less than 0.05 was considered statistically significant.

Results

The study population exhibited diverse demographic and socio-cultural backgrounds, with participants from various family types residing in urban and rural areas and representing various family income levels. A considerable proportion of participants in both groups reported having a regular newspaper/book reading habit, indicating an inclination towards staying informed and engaged with current knowledge and

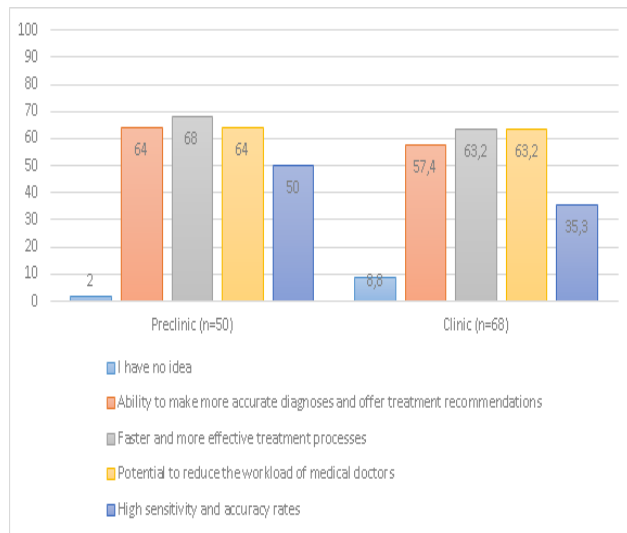


Figure 1. "What are the advantages of using artificial intelligence in medicine?" percentage distribution graph of the answers given by the participants to the question.

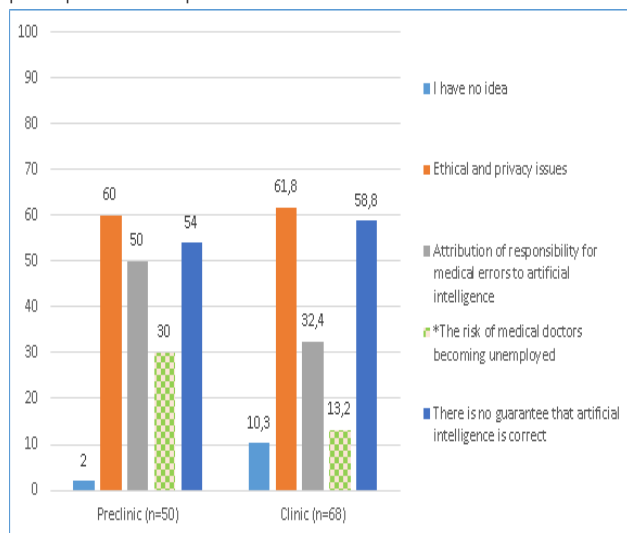


Figure 2. "What are the disadvantages of using artificial intelligence in medicine?" percentage distribution graph of the answers given by the participants to the question.

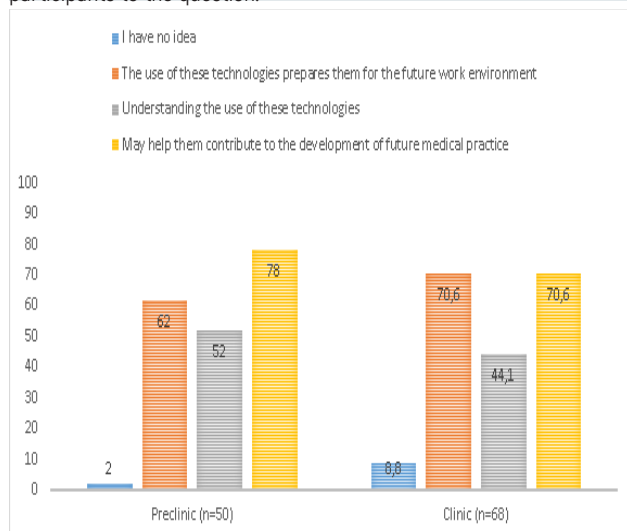


Figure 3. "What is the importance of artificial intelligence for medical students?" percentage distribution graph of the answers given by the participants to the question.

Table 1. Demographic data between groups.

	Preclinic (n=50)	Clinic (n=68)	p-value	
Age (Years)	20,1±1,34	26,4±4,19	<0.001	
Student class	1 st	32 (64%)	0 (0%)	<0.001
	2 nd	6 (12%)	0 (0%)	
	3 rd	12 (24%)	0 (0%)	
	4 th	0 (0%)	21 (30.9%)	
	5 th	0 (0%)	2 (2.9%)	
	6 th	0 (0%)	11 (16.2%)	
	Resident doctor	0 (0%)	34 (50%)	
Gender	Male	22 (44%)	30 (44.1%)	0.990
	Female	28 (56%)	38 (55.9%)	
Family type	Lives apart	0 (0%)a	13 (19.1%)b	0.003
	Nuclear family	43 (86%)a	50 (73.5%)a	
	Extended family	7 (14%)a	5 (7.4%)a	
Personality type	Type A	21 (42%)	34 (50%)	0.389
	Type B	29 (58%)	34 (50%)	
Family income status	Well	12 (24%)	19 (27.9%)	0.829
	Worse	4 (8%)	4 (5.9%)	
	Middle	34 (68%)	45 (66.2%)	
Mother's education status	Primary education	20 (40%)	32 (47.1%)	0.266
	High school	9 (18%)	17 (25%)	
	University	21 (42%)	19 (27.9%)	
Father's education status	Primary education	11 (22%)	19 (27.9%)	0.665
	High school	13 (26%)	19 (27.9%)	
	University	26 (52%)	30 (44.1%)	
Mother's working status	Not working	34 (68%)	46 (67.6%)	0.968
	Working	16 (32%)	22 (32.4%)	
Father's working status	Not working	9 (18%)	22 (32.4%)	0.080
	Working	41 (82%)	46 (67.6%)	
Place of residence	House	24 (48%)	66 (97.1%)	<0.001
	Dorm	26 (52%)	2 (2.9%)	
Regular newspaper/book reading habit	Well	11 (22%)a	5 (7.4%)b	0.037
	Worse	14 (28%)a	30 (44.1%)a	
	Middle	25 (50%)a	33 (48.5%)a	
Computer knowledge level	Well	8 (16%)	16 (23.5%)	0.531
	Worse	9 (18%)	9 (13.2%)	
Have you received any computer-related training?	Well	33 (66%)	43 (63.2%)	0.853
	Middle	17 (34%)	25 (36.8%)	
Have you received any computer-related training?	No	39 (78%)	54 (79.4%)	0.853
	Yes	11 (22%)	14 (20.6%)	

Data are presented as median, mean ± standard or n (%). Each same superscript (a, b) denotes a subset of group categories with no statistically significant difference from each other at the p 0.05 level.

developments. Regarding computer knowledge, most participants in both groups reported receiving computer-related training, highlighting their familiarity and preparedness in utilizing technology in the medical field. Notably, a significant proportion of participants in both groups expressed awareness of artificial intelligence (AI) and its applications, reflecting a growing recognition of AI's role in healthcare among future medical professionals. Demographic data between groups are compared in Table 1.

The survey revealed intriguing insights into the concerns and awareness of AI among the participants. Among the preclinical

Table 2. Responses of the participants of the two groups to the survey questions about artificial intelligence.

		Preclinic (n=50)	Clinic (n=68)	p value
Are you worried about robots entering our lives and communicating with humans?	No	29 (58%)	47 (69.1%)	0.213
	Yes	21 (42%)	21(30.9%)	
Have you ever heard of artificial intelligence?	No	0 (0%)	2 (2.9%)	0.507
	Yes	50 (100%)	66 (97.1%)	
Are you worried that artificial is doing so many things today?	No	28 (56%)	52 (76.5%)	0.019
	Yes	22 (44%)	16 (23.5%)	
How does the increasing inclusion of artificial intelligence in our lives make you feel about the future?	I have no idea	2 (4%)	4 (5.9%)	0.272
	It excites	10 (20%)	18 (26.5%)	
	It makes me look optimistic	2 (4%)	9 (13.2%)	
	Scares	11 (22%)	9 (13.2%)	
	Arouses curiosity	25 (50%)	28 (41.2%)	
Do you know about artificial intelligence applications used in medicine?	No	23 (46%)	40 (58.8%)	0.168
	Yes	27 (54%)	28 (41.2%)	
Would you like to use artificial intelligence in your medical life in the future?	No	1 (2%)	9 (13.2%)	0.043
	Yes	49 (98%)	59 (86.8%)	
Should artificial intelligence training be given in medical education?	No	2 (4%)	9 (13.2%)	0.115
	Yes	48 (96%)	59 (86.8%)	
Would you like to have artificial intelligence applications in medical school?	No	0 (0%)	7 (10.3%)	0.020
	Yes	50 (100%)	61 (89.7%)	
What is Chat GPT?	I have no idea	9 (18)	22 (32.4)	0.214
	It is a tool used in artificial intelligence programming	3 (6)	3 (4.4)	
	It is an artificial intelligence-based chatbot	38 (76%)	43 (63.2%)	
What do you think about the use of artificial intelligence in medicine?	I have no idea	0 (0%)	2 (2.9%)	0.322
	These technologies can help us make more accurate diagnoses and treatments in medicine	47 (94%)	59 (86.8%)	
	The use of these technologies in the medical field is ethically controversial	3 (6%)	7 (10.3%)	
Are you researching to learn more about artificial intelligence?	No, I'm not interested.	25 (50%)	42 (61.8%)	0.202
	Yes	25 (50%)	26 (38.2%)	
How much should you know about using artificial intelligence in medicine?	Middle	18 (36%)	32 (47.1%)	0.260
	Basis	3 (6%)	8 (11.8%)	
	Must be an expert	7 (14%)	9 (13.2%)	
	It must be a high level	22 (44%)	19 (27.9%)	

Data are shown as n [%].

students, 44% expressed worries about AI's increasing presence and its implications in various aspects of society. This concern was higher than in the clinical group, where 23.5% voiced similar apprehensions ($p < 0.05$). Additionally, a significant proportion of preclinical students (98%) indicated their desire to utilize AI in their future medical careers. Similarly, all preclinical students expressed an interest in incorporating AI applications into medical school.

Exploring the disadvantages of AI in medicine, the survey highlighted an interesting finding regarding the perceived risk of unemployment among preclinical medical students. When asked about the disadvantages of AI in the field of medicine, a higher percentage of preclinical students (30%) expressed concerns about the potential risk of being unemployed compared to the clinical group (13.20%) ($p < 0.05$). However, there were no significant differences between the groups regarding their knowledge and awareness of artificial intelligence or their attitudes towards its use in medicine. Table 2 shows the answers of the participants in the two groups to the questionnaire questions about artificial intelligence and their statistical comparisons.

Participants' opinions on the importance of AI in medicine provided valuable insights into their perspectives. Both preclinical and clinical groups recognized the significance of AI in the field of healthcare. Responses highlighted the potential advantages of AI in medicine, including improved diagnostic accuracy, enhanced treatment recommendations, and more efficient patient care processes. Furthermore, a substantial proportion of participants in both groups emphasized the importance of incorporating AI training into medical education, underscoring its role in preparing future medical professionals for the evolving healthcare landscape.

Discussion

The present study provides a comprehensive examination of the attitudes and perceptions of medical students towards AI in medicine. The findings shed light on various aspects, including concerns, interests, and recognition of the importance of AI among future medical professionals. Through a thorough analysis of the results, this discussion aims to explore the implications of these findings and their

significance in shaping the future of healthcare and medical education. One of the key findings of this study is the varying levels of concern expressed by preclinical and clinical medical students regarding the prevalence of AI in today's society. The higher level of worry among preclinical students suggests a sense of apprehension regarding the rapid integration of AI and its potential consequences. This concern may stem from uncertainties about the impact of AI on traditional medical practices and the perceived risk of being replaced by AI technologies. Medical educators and policymakers must address these concerns and provide reassurance regarding the complementary role that AI can play in enhancing rather than replacing human medical professionals [9-11]. Interestingly, both preclinical and clinical students expressed a strong interest in utilizing AI in their medical careers and incorporating AI applications into medical school. This enthusiasm signifies an acknowledgement of AI's potential medical benefits, such as improved diagnostic accuracy, enhanced treatment recommendations, and more efficient healthcare processes. Medical education institutions need to recognize and respond to this interest by incorporating AI training into the curriculum, equipping future medical professionals with the necessary skills to harness the full potential of AI technologies in patient care [12, 13].

The significantly higher proportion of preclinical students expressing concerns about the risk of unemployment compared to the clinical group warrants attention. This finding suggests that preclinical students may perceive AI as threatening future job prospects, potentially impacting their motivation and career choices. To address this concern, medical educators and professional bodies must emphasize the collaborative nature of AI-human interaction and highlight the importance of human expertise and judgment in medical practice [14]. By doing so, we can foster a positive mindset among preclinical students, promoting their engagement and active participation in shaping the future of medicine with AI as a valuable tool [15, 16].

Furthermore, the recognition of AI's importance in medical education underscores the need to integrate AI training into the curriculum. Medical schools must adapt their educational approaches to equip students with the knowledge and skills to navigate the evolving healthcare landscape [17-19]. Incorporating AI-focused courses, workshops, and experiential learning opportunities can empower medical students to become adept at leveraging AI technologies in their future practice (World Health Organization [2021]. WHO guideline on self-care interventions for health and well-being. World Health Organization). Additionally, fostering collaborations between medical institutions and AI experts can facilitate the development of AI applications tailored specifically to medical education needs, augmenting learning experiences and expanding the frontiers of medical knowledge [20].

Study Limitations

While this study provides valuable insights into the attitudes and perceptions of medical students towards AI in medicine, it is important to acknowledge several limitations that should be considered.

1. Sample limitation: The study primarily focused on a single institution, which may limit

the generalizability of the findings to a broader population of medical students. The perspectives and attitudes towards AI may vary among students from different geographic regions, cultural backgrounds, and educational settings. Future studies should include a more diverse sample to enhance the external validity of the findings.

2. Self-report bias: The data collected in this study relied on self-report measures subject to potential biases such as social desirability bias or

response bias. Participants may have provided answers they believed were expected or had difficulty accurately recalling their attitudes or AI-related experiences. Future studies could consider incorporating more objective measures or observational data to complement self-report measures.

3. Cross-sectional design: The study employed a cross-sectional design, capturing a snapshot

of participants' attitudes at a specific point in time. Longitudinal studies tracking the attitudes and perceptions of medical students over an extended period would provide a more dynamic understanding of how attitudes towards AI may change over time as students progress through their medical education.

4. Limited scope of the questionnaire: The questionnaire used in this study covered a wide

range of topics, including demographic information, AI awareness, and attitudes towards AI. However, it is possible that some relevant factors or dimensions related to AI perceptions were not included in the questionnaire. Future studies could explore additional aspects, such as specific concerns associated with AI ethics, the impact of AI on patient-doctor relationships, or attitudes towards AI in specific medical specialties.

5. Potential response bias: It is important to consider that participants who volunteered to

participate in the study may have had a higher interest or awareness of AI compared to those who chose not to participate. This could introduce a potential response bias and limit the generalizability of the findings to the broader population of medical students.

Despite these limitations, this study provides valuable insights into the attitudes and perceptions of medical students towards AI in medicine. The findings contribute to the existing literature and highlight the need for further research and targeted interventions to address concerns, promote interest, and effectively integrate AI into medical education and practice.

Conclusion

In conclusion, the findings of this study underscore the transformative potential of AI in medicine and highlight the need for proactive measures to address concerns, foster interest, and integrate AI training into medical education. By embracing the possibilities and challenges presented by AI, we can collectively shape a future where human expertise and AI technologies synergistically work together to deliver optimal patient care. The journey towards a technologically advanced healthcare system requires ongoing collaboration, open-mindedness, and a commitment to ensuring that the human element remains at the heart of medical practice. Together, we can pave the way for a future where AI empowers and augments the capabilities of medical professionals, ultimately benefiting patients and advancing the field of medicine into new frontiers of excellence. However, it is important to acknowledge the limitations of this study, such as the sample bias and the cross-sectional design. Future research should aim to include a more diverse range of participants and employ longitudinal approaches to track the evolving attitudes towards AI throughout medical education.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of

the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

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Conflict of interest

The authors declare no conflict of interest.

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